Understanding consumer decisions using behavioral economics

Zandstra, Elizabeth H ; Miyapuram, Krishna P ; Tobler, Philippe N

Abstract: Consumers make many decisions in everyday life involving finances, food, and health. It is known from behavioral economics research that people are often driven by short-term gratification, that is, people tend to choose the immediate, albeit smaller reward. But choosing the delayed reward, that is, delaying the gratification, can actually be beneficial. How can we motivate consumers to resist the "now" and invest in their future, leading to sustainable or healthy habits? We review recent developments from behavioral and neuroimaging studies that are relevant for understanding consumer decisions. Further, we present results from our field research that examined whether we can increase the perceived value of a (delayed) environmental benefit using tailored communication, that is, change the way it is framed. More specifically, we investigated whether we can boost the value of an abstract, long-term "green" claim of a product by expressing it as a concrete, short-term benefit. This is a new application area for behavioral economics.

DOI: https://doi.org/10.1016/B978-0-444-62604-2.00012-5

Originally published at:
Zandstra, Elizabeth H; Miyapuram, Krishna P; Tobler, Philippe N (2013). Understanding consumer decisions using behavioral economics. In: Chandrasekhar Pammi, V S; Narayanan, Srinivasan. Decision Making - Neural and Behavioural Approaches. Amsterdam: Elsevier, 197-211.
DOI: https://doi.org/10.1016/B978-0-444-62604-2.00012-5

Understanding Consumer Decisions Using Behavioural Economics

Elizabeth H. Zandstra[1*], Krishna P. Miyapuram[1,2], Philippe N. Tobler[3]

[1] Sensation, Perception & Behaviour, Unilever R&D Vlaardingen, P.O. Box 114, 3130 AC Vlaardingen, The Netherlands. E-mail: liesbeth.zandstra@unilever.com.
[2] Center for Mind/Brain Sciences (CIMeC), Università degli Studi di Trento, Via delle Regole 101, 38060 Mattarello (TN), Italy. E-mail: krishna.miyapuram@cantab.net.
[3] Laboratory for Social and Neural Systems Research, Department of Economics, University of Zurich, Blümlisalpstrasse 10, CH-8006 Zurich, Switzerland. E-mail: phil.tobler@econ.uzh.ch.

* Corresponding Author

Abstract: Consumers make many decisions in everyday life involving finances, food and health. It is known from behavioural economics research that people are often driven by short-term gratification, i.e. people tend to choose the immediate, albeit smaller reward. But choosing the delayed reward, i.e. delaying the gratification, can actually be beneficial. How can we motivate consumers to resist the 'now' and invest in their future, leading to sustainable or healthy habits? We review recent developments from behavioural and neuroimaging studies that are relevant for understanding consumer decisions. Further, we present results from our field research that examined whether we can increase the perceived value of a (delayed) environmental benefit using tailored communication, i.e. change the way it is *framed*. More specifically, we investigated whether we can boost the value of an *abstract, long-term* 'green' claim of a product by expressing it as a *concrete, short-term* benefit. This is a new application area for behavioural economics.

Key words: Neuroeconomics; decision making; consumer preference; environmental benefits; health benefits; immediate rewards; delayed rewards; intertemporal choice.

Introduction

Many decisions in day-to-day life involve considering alternatives that will occur at some point in the future. Consider for example, when given a choice between choosing $5 now or $10 in two weeks time, people tend to choose the immediate, albeit smaller reward. Recent developments in behavioural economics and neuroeconomics research has increased our understanding of how people make decisions in various contexts. Behavioural economics is a research field that uses psychological science to understand how people make economic decisions (Kahneman & Tversky, 1979; Camerer, 1999). This field recently expanded into neuroeconomics that looks at the role of the brain when people evaluate decisions, categorize risks and rewards, and how these interact with each other (Loewenstein *et al.*, 2008). Of particular interest is the time-discounted utility theory in this – so far mainly used in economics. Time-discounting describes the subjective devaluation of outcomes as a function of the time delay until their delivery, such that immediate rewards are more highly valued and hold a greater control over behaviour than those which are delayed (Frederick *et al.*, 2002). This chapter will discuss recent developments in our understanding of factors that influence consumers' decisions, with a particular focus on discounting behaviour around immediate and delayed rewards of fast moving consumer goods (FMCG). This is followed by some data on boosting the value of delayed rewards in order to make them more motivating for consumers. Finally, we discuss the implications of such research and identify new avenues for research.

Psychological theories have emphasised the importance of rewards in decision making. Rewards have been defined operationally as stimuli which positively reinforce behaviour, and increase the frequency and intensity with which behaviours are elicited (Berridge & Robinson, 2003; McClure *et al.*, 2004b). Rewards may be either primary or secondary in nature. Primary rewards such as food, water or sexual stimuli, have the ability to reinforce behaviour without the need to be learnt, whereas secondary rewards, such as money, receive their reward value by being associated with primary rewards through conditioning (Rolls, 2007). In decision making situations involving choice behaviour, individuals choose the option that yields the highest expected reward value. The equivalent concept from behavioural economics is that of the utility function, which combines several parameters of each option into one single unitary value. In this way, decisions among several alternatives are driven by the aim of maximising utility. The key assumption here is that the utility function provides a way of quantifying the subjective reward value that an individual attaches to each option. We propose that the concept of utility functions can be applied to better understand consumer decision making in a principled way.

In recent years, a lot of interest has arisen towards neuroeconomics to determine where aspects of decision making occur in the brain and to investigate how the brain computes reward value. Also, building on the utility framework, more and more studies addressed the question whether there exists a region of the brain that commonly encodes decision values for different types of rewards, or if, in contrast, the values of different types of rewards are represented in distinct brain regions (Chib *et al.*, 2009). The results of these studies have systematically revealed that the utility is represented in the so-called reward centers of the brain (Knutson et al., 2005). Neurophysiological studies in animals have provided the primary basis for identifying the core neuronal circuitry underlying rewards. This core reward circuitry is composed of the ventral striatum and orbitofrontal cortex, both receiving inputs from the dopaminergic neurons in the substantia nigra and ventral tegmental areas in the midbrain (see Schultz (2000) for review). Neuroimaging studies in humans show similar findings and have revealed activation in analogous brain regions to various rewarding stimuli and predictors of reward (see O'Doherty (2004) for review). Chib *et al.* (2009) asked participants in the fMRI scanner to make purchasing decisions among different types of rewards (i.e. food, nonfood consumables and monetary gambles) and they found activity in the ventromedial frontal cortex to be correlated with subjects' valuations for all types of rewards. These results have been confirmed by Kim *et al.* (2011) who found that secondary rewards such as money activated the same reward regions as primary rewards such as juice (Kim *et al.*, 2011). Furthermore, pictures of appetizing foods activate the same reward regions of the brain as the actual experiences that occur while actually consuming these foods (Simmons *et al.*, 2005). These neural findings have significantly contributed to our understanding that a common reward valuation system is responsible for processing different types of reward.

Neuroeconomic methods have also shown that the neural mechanisms underlying consumer decisions could reliably predict consumer choices (see Kenning & Plassmann (2008) for a review; Tusche *et al.,* 2010). For example, Knutson *et al.* (2007) showed that nucleus accumbens activity predicted an upcoming purchase decision when viewing a product, *even before price information was known*. In addition, Levy *et al.* (2011) showed that the activation in the striatum and medial prefrontal cortex during passive viewing of products reliably predicted subsequent choices made outside the scanner. In a similar vein, Plassmann *et al.* (2007) found that the medial orbitofrontal cortex encoded 'willingness to pay' for 50 different sweet and salty snack foods (e.g. chips and candy bars) by hungry subjects. Until now, as far as we are aware, most research has focused on preference for immediate rewards, and have not addressed how we can boost the utility of delayed rewards. However, several choices also involve making decisions regarding potential future rewards, a topic of high relevance to understand consumer decision behaviour.

Intertemporal Choice & Delayed Gratification

Why is it difficult to save for a pension or maintain a healthy diet? Intertemporal choices are decisions about future and delayed consequences and occur in most of our decisions in daily life, such as adopting and maintaining a healthy lifestyle, investing in a health insurance or saving for a pension (Berns *et al.*, 2007). This temporal aspect in decision making involves trade-offs between immediate consumption and considerations about better future payoffs. Such intertemporal choices present a challenge for a decision maker, as there is a tendency to favour immediate gratification over benefits which are delayed in the future: instant gratification often appears to be far too much a temptation (Blackburn, 2012; Blackburn *et al.*, 2012). The discounted utility model (Samuelson, 1937) posits that decisions are made as a weighted sum of utilities with temporal discount factors as weights. This model assumes a constant discount rate, which ensures that a preference between two delayed options is only dependent on the time delay between them. The order of preferences should be preserved at all possible time points (time consistency or stationarity). This behaviour is implemented by an exponential form of discounting into the equation.

$V = Ae^{-kd}$, where V is the discounted value, A is the absolute value, *k* is a constant discounting parameter and *d* is the delay. (Equation 1)

Consider the example when given a choice between choosing \$5 now or \$10 in two weeks. The smaller sooner reward (\$5 now) may be preferred compared to the larger delayed reward (\$10 in 2 weeks) because the value of the future reward is discounted below the value of the immediate reward (Equation 1; Figure 1). Now, consider that both options in the above gamble are further delayed by one week. The exponential model of discounting suggests that the smaller sooner reward (\$5 in one week) would still be preferred over the larger later reward (\$10 in 3 weeks). However, behavioural experiments showed that people fail to conform to such a prediction (Berns *et al.*, 2007). Thus, a preference reversal occurs if people prefer the larger delayed reward in one but not the other situation. This behaviour is captured by the hyperbolic discounting model (Equation 2; Figure 1). The latter finding is particularly relevant for consumer behaviour, i.e. how to motivate consumers to resist the now and invest in future rewards.

$V = \frac{A}{1+kd}$, where the different symbols hold the same meaning as Equation 1. (Equation 2)

-- INSERT FIGURE 1 HERE--

Neuroeconomic findings argue that immediate and future rewards are represented by either a unitary system, in which discounting arises as a function of a single valuation mechanism, or a dual system, which focuses on the interaction between two separate decision processes that have competing goals. Neuroeconomic research tried to address both discounting mechanisms in decision making. For example, Kable and Glimcher (2007) showed that neural activity in ventral striatum, medial prefrontal cortex and posterior cingulate cortex tracked the subjective value of delayed monetary rewards when participants choose between a fixed immediate reward of $20 and a larger delayed reward, a value in the range from $20.25 to $110, available after a delay ranging from 6 hours to 180 days. With the help of a quasi-hyperbolic discount function, McClure *et al.* (2004a) found separate neural systems underlying immediate and delayed rewards. They examined neural correlates of time discounting while subjects made a series of choices between monetary reward options that varied by delay (same day to 6 weeks later) to delivery. They found that ventral striatum, medial OFC, medial prefrontal cortex (PFC), posterior cingulate and left posterior hippocampus were related to choices of immediate rewards. In contrast, regions of lateral prefrontal cortex and posterior parietal cortex were engaged uniformly by intertemporal choices irrespective of delay. In a subsequent study, McClure *et al.* (2007) used primary rewards (fruit juice or water) with time delays of minutes instead of weeks and found similar activation patterns as in their previous study. The studies of Kable & Glimcher (2007) and McClure *et al.* (2004a; 2007) provided evidence for unitary and dual system accounts of processing immediate and delayed rewards, respectively.

Prior research has mainly considered temporal discounting of monetary rewards in humans and primary rewards such as food in animals. Given that the neural substrates of different goods overlap, it is critical to consider whether temporal discounting behavior is domain specific or not. Tsukayama and Duckworth (2010) examined intertemporal choice for money (dollars) and three food-related consumables (candy bars, chips and beer) at five different delays – one week, one month, six months, one year, and three years. A domain-general discounting was revealed by positive correlation for discounting rates for the four categories. However, steeper discounting was found for items that individuals found more tempting. In another study comparing financial, environmental and health gains or losses available immediately or after a delay of 1 or 10 years, Hardisty and Weber (2009) found that discount rates are influenced more by the valence of outcomes (gains or losses) than by domain (i.e. money, environment or health). More importantly, at short or medium delays, they found that environmental outcomes were discounted in a similar way as financial outcomes. This recent behavioural work opens a new area of application for behavioural economics to outcomes involving health and environmental benefits.

An active area of research parallel to intertemporal choice paradigms is that of delayed gratification – the ability to wait over a delayed time interval to receive the desired reward. In the classic marshmallow test by Mischel *et al.* (1989), pre-school children were encouraged to resist the temptation of eating a single piece of their favourite confectionary while the experimenter was absent from the room up to 15 minutes. In exchange, children who could successfully delay the gratification would be offered two pieces of their preferred confectionary. The observation of childrens' behavior revealed different cognitive strategies - by focusing on the 'hot' properties such as the taste of the confectionary led the child to be more impulsive, while focusing on the 'cool' properties such as the shape of the object or other types of distractions, children were able to wait for longer. A remarkable finding is that the delay gratification measures of these pre-schoolers could successfully predict their scholastic achievements as adolescents (Mischel *et al.*, 1989). A recent brain imaging study examined cognitive control strategies on a subset of the original study's participants using a go/no-go paradigm (Casey *et al.*, 2011). Activation in the inferior frontal gyrus was greater for high delayers, whereas activation in ventral striatum was greater for low delayers. The findings from these longitudinal studies (spread over four decades) expand our knowledge on individual differences in self-control and the appropriate strategies for cognitive control.

Cognitive Modulation of Immediate Rewards

Reward processing has received a lot of attention in psychology and in the neurosciences, and our understanding of neurological systems underlying reward processing has increased tremendously in the last decade. To date, most of this research has focused on bottom-up processing, i.e. involving stimuli that are innately seen as rewards/punishments. Less attention has, however, been paid to top-down processing, i.e. the influence of expectations – based on prior knowledge, our own thoughts and ideas, information, emotions – on the processing of rewards.

Expectations are an important tool for humans, helping us to predict daily life and to deal with uncertainties. These expectations have an influence on how we perceive and even on what we perceive. For consumers, expectations of product performance through price or brand communication such as advertising and packaging play a significant role in deciding whether to buy a product or not. There are a number of behavioural food studies that showed that expectations influence the perception and reward value of a food (Cardello, 2007; Deliza & MacFie, 1996; Winkielman *et al.*, 2005). For example, the expectation of a red wine will change the taste description of a coloured white wine (Morret *et al.*, 2001), and believing in the effect of an ingredient can lead to a strong placebo effect (Kuenzel *et al.*, 2011).

More and more neuroimaging studies have been conducted that support that expectations influence the reward value of a stimulus (de Araujo *et al.*, 2005; McClure *et al.*, 2004b; Plassman *et al.*, 2008). A key experiment was carried out by de Araujo *et al*. (2005) using the odour isovaleric acid. They presented participants this odour in combination with different cognitive labels. When the odour was labelled with 'cheese', subjects expressed liking the odour more than when it was labelled with 'body odour'. Moreover, different areas in the brain were activated depending on the cognitive labels presented. Another study focussed on the effect of brand preference on reward processing of a primary reward like a sugared drink (McClure et al., 2004b). McClure *et al.* (2004b) presented participants two drinks, Pepsi and Coke, which are essentially sweet brown liquids with similar taste and sugar content. They gave participants the drinks unbranded and showed that the sugar in it leads to an activation of reward processes in the brain, more specifically in the ventromedial prefrontal cortex. Interestingly, they then gave participants the drinks branded and showed that -for subjects who preferred Coke over Pepsi- more reward-related brain areas were activated when the Coke brand was shown, compared to when the Pepsi brand was shown. These brain areas (the hippocampus and the dorsolateral prefrontal cortex) have been associated with emotion and affect. This shows that the reward can be generalised to a brand. In a similar vein, Plassmann *et al.* (2008) showed that other marketing actions, such as changes in price of a product, can affect neural representations of experienced pleasantness. They asked subjects to taste (identical) wines that they believed to be different and sold at different prices. They hypothesised that a higher price would result in higher taste expectations and hence would lead to higher activity in the medial orbitofrontal cortex (mOFC), an area in the brain that is widely thought to encode for experienced pleasantness. The results were consistent with this hypothesis: the reported price of wines markedly affected self-reported experienced pleasantness and, more importantly, also modulated the blood-oxygen-level-dependent (BOLD) signal in the mOFC. These results show that a reward value of a food not only depends on the sensory properties of the food and/or the current state of the consumer: the brain computes a reward value in a much more sophisticated manner that involves integrating the sensory properties of the food being consumed with the expectations about how good it should be.

Little is known about how top-down effects influences choice behaviour. In a laboratory behavioural experiment using a within-subjects design, Zandstra & El-Deredy (2011) gave 44 subjects one of two yoghurt drinks, alternating between high-energy and low-energy yoghurt drinks (255 kcal and 57 kcal per 200ml serving, respectively), first thing in the morning following 8 hours of fasting, every day for two weeks, with 5 exposures to each yoghurt drink on alternate days. Both drinks were similar in appearance, texture, taste etc. Participants were not aware that the drinks differed in any way, except that one drink was paired with a blue label, and the other with a pink label, with the pairings fully counter-balanced. Every day of the third (test) week, participants were given the choice of either having the pink or the blue labeled yoghurt drink. Participants did not differentiate between the yoghurt drinks in terms of how much they said they liked them. However, clear and pronounced effects were found for the behaviour measure preference: even though the yoghurt drinks were *equally* liked, participants chose the high energy drink significantly more often over the low energy drink. This suggests a conditioned preference for a delayed physiological (energy) reward. Further evaluative conditioning research with food stimuli under realistic choice conditions in a natural (everyday life) context is needed to confirm this conclusion. We are now beginning to study the neural correlates of this behaviour with a view to being able to better understand and perhaps predict subjects' choices. Are different reward areas of the brain being activated by the two drinks? Is there any mismatch between what we expect and what we observe?

To recapitulate, just as in behavioural studies, neuroimaging studies do support the influence of a number of different top-down effects on the reward value of stimuli. These top-down influences are strong enough to override bottom-up effects such as sensory stimulation and they potentially drive choice behaviour. Therefore, it is critical to take all these different aspects of a product into account to create a maximised *immediate* rewarding experience.

Boosting Delayed Rewards

An immediate rewarding experience is delivered directly at the point of consumption (e.g. price, efficacy), whereas delayed rewards are characterized by a delay, i.e. it takes months or even years until effects can be measured (e.g. health or sustainability). Even though delayed rewards are motivating for consumers in the long-term, it takes time before they are actually perceived by consumers. Decision making in relation to health and sustainability is therefore not readily predictable as these rewards are less tangible, more impersonal and delayed. Consumers will ask themselves: 1) ''will I receive a reward?'', 2) ''when will I receive a reward?'', and 3) ''what reward will I receive?''. As mentioned before, behavioural economics research shows that consumers are often driven by short-term gratification: people tend to choose the sooner, smaller reward. It is therefore critical to address this for behaviours around health and sustainability. The challenge here will be to turn delayed and impersonal rewards into personally (immediately) perceivable rewards. This, in the end, will maximise the *delayed* rewarding experience.

So far, the paradigms that tested for choices between immediate and delayed rewards have mainly been concerned with impulsive choices (e.g. McClure *et al.*, 2004a). Little is known about how to best promote choices of products with delayed rewards. When it comes to higher order choice motivations such as health and sustainability, there is a considerable attitude-behaviour gap (Sheeran, 2002), i.e. consumers "talk healthy" or "talk green" but "don't walk it". For example, Weijzen *et al.* (2008) found a substantial inconsistency between healthful stated snack choice intentions and actual behaviour. Participants were asked about their intentions in choosing among four snacks: an apple, a banana, a candy bar and a waffle. About half of the participants indicated they would choose the apple or banana - a "healthy" snack. But when presented with the actual snacks one week later, 27% switched to the candy bar or waffle. Over 90% of the unhealthy-choice participants stuck with their intentions and chose the unhealthy snack. This demonstrates that intentions are usually under cognitive control while actual choices are often made impulsively, even unconsciously.

Behavioural economics might enable us to explore the dynamics of these decisions in more detail. The behavioural economics approach has been investigated extensively in the financial domain. Recent developments show that this approach can be extended to other domains such as food (Epstein *et al.*, 2010). Consider the following scenario: given a choice between a tasty, but potentially unhealthy food (e.g. a burger) available immediately and a second option which involves resisting the temptation now and choosing to have a healthy weight in future, usually people would want both. However, the consequences and antecedents for these two choices are very different. Choosing a high fat food is ultimately detrimental to your body weight and the choice of maintaining a healthy weight requires eating low fat foods such as vegetables. In order to promote the healthy option, we could potentially think of two policies – either make people pay more for the burger or make vegetables a much cheaper food. Classical economics theory suggests that if the price of a particular food *de*creases, choice for that food will *in*crease, and vice versa. However, recent research by Epstein *et al.* (2010) showed that providing subsidy on healthier foods is not a good strategy, as the consumers will use the money saved to invest back into the unhealthy option.

In our current research, we explored whether the behavioural economics approach can be extrapolated to sustainability as well. As indicated before, environmental benefits are extremely delayed in time, which makes them less tangible compared to immediate benefits, such as price and efficacy. A consumer is unlikely to directly experience many environmental benefits in his/her life time. A green claim, therefore, is not a directly perceivable reward and appeals to consumers only through their individual belief in environmental benefits (Bolderdijk, 2011). Moreover, in our research we draw on construal level theory and build on the assumption that environmental benefits are not the primary, but are rather secondary drivers of product choice because of their perceived psychological distance to the 'now', *i.e.* a primary benefit 'what the product does for you' *vs.* a secondary benefit 'with what social and ecological impact the product does it' (Trope *et al.*, 2007; Trope & Liberman, 2010). Both primary and secondary benefits may be salient and relevant to the consumer, but in terms of determinance in guiding behaviour primary benefits typically take priority. Especially when primary and secondary benefits are to some extent at odds, social dilemma theory indeed indicates that it is more likely that primary benefits will be persued to direct need satisfaction than that people sacrifice their immediate self-interest for long-term collective benefit (Balliet *et al.*, 2011; Van Lange *et al.*, 1998).

Therefore, the question we asked ourselves is whether we can boost the utility curve of a delayed reward in a product by re-framing it as a primary benefit. For example, one could frame a green claim by only emphasising the green benefit (*e.g.* 'With this soup we help to protect the planet's natural resources, as it is made with eco-friendly tomatoes.'), or one could frame a green claim by expressing it as a primary benefit (*e.g.* 'This soup is a great tasting soup, as it is made with eco-friendly tomatoes, which also helps to protect the planet's natural resources.').

Previous research showed that re-framing delayed outcomes can impact the ability to consider future consequences (Tversky & Kahneman, 1981). One approach is to raise awareness about environmental issues and the individual consumer role and responsibility by educating the consumer using explicit and tailored information, spelling out what the consumer needs to do. For example, in hotel rooms guests are generally pointed at the threat posed to the environment from the daily cleaning of towels. They are kindly asked to re-use their towels in order to protect the environment by not dropping them on the floor. Goldstein *et al.* (2008) demonstrated that when guests were made aware of the fact that "the majority of guests *in this room* have re-used their towels", they were more likely to re-use their towels as well. Interestingly, just by re-framing it and making it more personally relevant, consumers showed more sustainable behaviour.

Experiment into boosting delayed rewards

In a laboratory experiment, we examined whether we can increase the perceived value of a (delayed) environmental benefit using tailored communication, *i.e.* by changing the way it is *framed*. More specifically, we investigated whether we can boost the value of an *abstract, long-term* green claim in a home care product by expressing it as a *concrete, short-term* benefit. The key question was: Which combinations of primary and green benefits works the best in boosting the utility of the delayed reward?

Participants - A total of 254 consumers were recruited within the UK for an in-home or at work internet-based study. Among these were 117 males and 137 females with an average age of 39 ± 9.6 years. The sample was representative of the wider population in terms of socioeconomic status, educational level and income level. Participants received a small incentive for participation in the study.

Stimuli - We tested six primary benefits with four green claims. The green claims varied on three parameters: type of green claim, quantity of green claim and time to achieve the green claim. From available data from an environmental calculator at internet, average savings per months were calculated for each claim type (*e.g.* saving 500 trees in 1 month). Four time points (3 months, 6 months, 1 year and 2 years) were chosen to enable us to construct the utility curves. To match with the four time points, the average monthly environmental savings were multiplied by the duration (*i.e.* 3, 6, 12, or 24 months) to give four different quantities. For a given green claim type, the quantity and time were varied independently, with the contraint that any given choice set with a repeated type of green claim should satisfy the following condition: longer time to achieve the green claim should always be accompanied by increased quantity of environmental savings. A linear relationship between time and quantity was not enforced to ensure that these two parameters were orthogonal. The research reported here focusses on the results of only one of the four green claims as similar results were observed for the other green claims.

Procedure - Using a conjoint, 3-alternative forced choice approach, we asked consumers to choose one among three pairs of statements: "Which statement would motivate you the most to buy home care product 'X'?". Each pair of statements consisted of a primary and a green claim. Participants indicated their choice by selecting a radio button at the bottom of the screen. In total, participants completed 8 such choice tasks.

Data analysis - Hierarchical Bayesian models were fitted to the observed choice data. The choice of models was based on their root likelihood ratio (RLH). The maximum RLH was set to 1000. If respondents chose completely randomly among the three alternatives that were presented, the root likelihood ratio (RLH) would be 1000/3=333. Three Hierarchical Bayesian models were fitted to the choice data: model I included only the main effects (RLH 535), model II included main effects and significant interaction effect of (green claim)x(quantity of green claim) (RLH 557), and model III included main effects with relevant interaction effects, i.e. (primary claim)x(green claim), (type of green claim)x(quantity of green claim), (type of green claim)x(time to achieve green claim), (quantity of green claim)x(time to achieve green claim) (RLH 659). Model III with the highest RLH was used for reporting the results. The advantage of using a hierarchical bayesian model over traditional models such as logit was that we could estimate the utilities for each participant for *all* the choices, even though they would have actually responded to only a subset of the choice set.

-- INSERT FIGURE 2 HERE--

Results - Figure 2 shows the perceived value of one of the green claims using tailored communication. Inspection of Figure 2 shows that the perceived value (estimated utilities) decreased over time corresponding to standard utility curves in behavioural economics. Also, we observed a shift in the utility by expressing the green claim as a primary benefit. Statistical analysis confirmed these clear differences in utility curves ($p<0.05$), even though the discounting factor (k) was small. Further, we do not notice a change in the slope of the utility curves [no significant interaction effect ($p>0.05$) of (green claim)x(primary benefit)].

Conclusion - We confirmed our hypothesis that by appropriately communicating the green claim as a primary benefit, we can boost the perceived value of it. Therefore, to motivate consumers to buy a product with an environmental benefit, it needs to have a green claim expressed as a concrete and short-term benefit.

Conclusions and Future Directions

Sustainability is a new application area for behavioural economics. This approach for the study of delayed rewards can be extended to other domains such as reducing obesity (Just & Payne, 2009) and improving cardiovascular health (Fair *et al.*, 2008). The research in this area will probably be most successful if it takes a holistic approach into account, i.e. focusing on product, packaging and communication as well as on the consumer and the context in which a product is consumed and used.

Future research should focus on the neural integration of primary and environmental benefits. So far, it is unclear whether environmental benefits are processed in the same way as primary benefits and whether the two are actually incorporated into a single utility processing module in the brain. If this were the case, then trade-offs between immediate primary and delayed environmental benefits would indeed be real and one would be more confident that one can substitute for the other. In a similar vein, it would be of interest to investigate whether environmental benefits are encoded in the activations of brain regions that process also primary benefits and how these or other brain activations predict actual choice behaviour. For the latter, it is critical to design studies to better link brain responses to real decisions, and there is a clear need for long-term studies of repeated choice and consumption.

Over the past decade we have learned that there are tremendous individual differences in brain responses. We therefore expect that there will be individual differences in the degree to which primary and environmental benefits are weighted. A brain region integrating the two types of benefits would show stronger activation to higher levels of primary benefits and further enhancement of signals by larger environmental benefits if participants value these benefits positively or suppression of signal if they value them negatively. Moreover, activation should be equal if the sum of environmental and primary benefits is equal, such that an increase in one can substitute for a decrease in the other. We predict such brain regions to include the striatum and parts of the prefrontal cortex.

To conclude, in this chapter we have explored the behavioural economics approach with a focus on delayed rewards. Behavioural economics studies have provided a principled approach to understand consumer decisions. Neuroeconomics research gives us three unique insights in understanding consumer decisions: 1) the core reward circuitry in the brain is activated by different kinds of rewards, 2) temporal aspects of decisions, i.e. immediate and delayed rewards, are represented in the brain, and 3) expectations influence the perceived value of rewards. Together, behavioural and neuroimaging findings have suggested that 'framing' could be a way forward to boost the value of delayed rewards. We confirmed our hypothesis that by appropriately communicating a green claim, we can boost the perceived value of it. Therefore, to motivate consumers to buy a product with an environmental benefit, it needs to have a green claim expressed as a concrete and short-term benefit. This is a new application area for behavioural economics, which has so far been mainly implemented for monetary rewards. There is much more potential for consumer relevant research, for example in rational decision making and prediction of actual choice behaviour.

Acknowledgements

The authors thank Dr. Marianna Blackburn, Prof. Dr. Garmt Dijksterhuis, Ilse Gortemaker, Dr. Anna Thomas and Prof. Dr. Hans van Trijp for useful and stimulating discussions concerning this work.

References

de Araujo, I.E., Rolls, E.T., Velazco, M.I., Margot, C. & Cayeux, I. (2005). Cognitive modulation of olfactory processing. *Neuron*, 46: 671-679.

Balliet, D., Mulder, L.B., & Van Lange, P.A.M. (2011) Reward, punishment, and cooperation: A meta-analysis. *Psychological Association*, 137(4): 594-615.

Berns, G.S., Laibson, D., & Loewenstein, G. (2007). Intertemporal choice - Toward an integrative framework. *Trends in Cognitive Sciences*, 11: 482-488.

Berridge, K.C. & Robinson, T.E. (2003). "Parsing reward." *Trends in Neurosciences*, 26(9): 507-513.

Blackburn, M. (2012). Decision making under uncertainty: Differentiating between 'If', 'What' and 'When' outcomes occur. *PhD Thesis*, University of Manchester, U.K.

Blackburn, M., Liam, M., Hoeksma, M., Zandstra, E.H. & El-Deredy, W. (2012). Delay discounting as emotional processing: An electrophysiological study. *Cognition & Emotion*, iFirst article, 1-16, DOI:10.1080/02699931.2012.673478.

Bolderdijk, J.W. (2011). Buying people: The persuasive power of money. *PhD Thesis* Rijksuniversiteit Groningen, The Netherlands. http://irs.ub.rug.nl/ppn/334141206.

Camerer, C. (1999). Behavioral economics: Reunifying psychology and economics. *Proceedings of the National Academy of Sciences of the U.S.A.* 96(19): 10575-10577.

Cardello, A.V. (2007). Measuring consumer expectations to improve food product development. In H.J.H. Macfie (Ed.) Consumer-led food product development. Cambridge: Woodhead Publishing pp. 223-261.

Casey, B.J., Somerville, L.H., Gotlib, I.H., Ayduk, O., Franklin, N.T., Askren, M.K., Jonides, J., Berman, M.G., Wilson, N.L., Teslovich, T., Glover, G., Zayas, V., Mischel, W. & Shoda, Y. (2011). Behavioral and neural correlates of delay of gratification 40 years later. *Proceedings of the National Academy of Sciences of the U.S.A.*, 108(36): 14998-5003.

Chib, V.S., Rangel, A., Shimojo, S. & O'Doherty, J.P. (2009). Evidence for a common representation of decision values for dissimilar goods in human ventromedial prefrontal cortex. *Journal of Neuroscience*, 29(39): 12315-12320.

Deliza, R. & Macfie, H.J.H. (1996).The generation of sensory expectation by external cues and its effect on sensory perception and hedonic ratings: A review. *Journal of Sensory Studies*, 11: 103-128.

Epstein, L.H., Dearing, K.K., Roba, L.G., & Finkelstein, E. (2010). The influence of taxes and subsidies on energy purchased in an experimental purchasing study. *Psychological Sciences*, 21(3):406-14.

Fair, A.K., Murray, P.G., Thomas, A. & Cobain, M.R. (2008). Using hypothetical data to assess the effect of numerical format and context on the perception of coronary heart disease risk. *American Journal of Health Promotion*, 22(4):291-6.

Frederick, S., Loewenstein, G. & O'Donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of Economic Literature*, 40: 351–401.

Goldstein, N.J., Cialdini, R.B. & Griskevicius, V. (2008). A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. *Journal of Consumer Research*, 35: 472-482.

Hardisty, D.J. & Weber, E.U. (2009). Discounting future green: money versus the environment. *Journal of Experimental Psychology: General*, 138(3): 329-40.

Just, D.R. & Payne, C.R. (2009). Obesity: can behavioral economics help? *Annals of Behavioural Medicine*, 38(1): S47-S55.

Kable, J.W. & Glimcher, P.W. (2007). The neural correlates of subjective value during intertemporal choice. *Nature Neuroscience*, 10(12): 1625-1633.

Kahneman, D. & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, 47(2), 263-291.

Kenning, P.H. & Plassmann, H. (2008). How neuroscience can inform consumer research. IEEE Trans *Neural Systems and Rehabilitation Engineering*, 16(6): 532-538.

Kim, H., Shimojo, S. & O'Doherty, J.P. (2011). Overlapping responses for the expectation of juice and money rewards in human ventromedial prefrontal cortex. *Cerebral Cortex*, 21(4): 769-776.

Knutson, B. & Peterson, R. (2005). Neurally reconstructing expected utility. *Games and Economic Behavior*, 52(2): 305-315.

Knutson, B., Rick, S., Wimmer, G.E., Prelec, D. & Loewenstein, G. (2007). Neural predictors of purchases. Neuron, 53(1): 147-56.

Kuenzel, J., Barton, C., Blanchette, I., Zandstra, E.H., Thomas, A., & El-Deredy, W. (2011). Awareness changes placebo effects for feeling relaxed, but not for liking. *Journal of Marketing Communications*, iFirst article: 1-18.

Levy, I., Lazzaro, S.C., Rutledge, R.B. & Glimcher, P.W. (2011). Choice from non-choice: predicting consumer preferences from blood oxygenation level-dependent signals obtained during passive viewing. *Journal of Neuroscience*, 31(1): 118-125.

Loewenstein, G., Rick, S. & Cohen, J.D. (2008). Neuroeconomics. *Annual Review of Psychology*, 59: 647-672.

McClure, S.M., Laibson, D.I., Loewenstein, G. & Cohen, J.D. (2004a). Separate neural systems value immediate and delayed monetary rewards. *Science*, 306(5695): 503-507.

McClure, S.M., Li, J., Tomlin, D., Cypert, K.S., Montague, L.M. & Montague, P.R. (2004b) Neural Correlates of Behavioral Preference for Culturally Familiar Drinks. *Neuron*, 44: 379–387.

McClure, S.M., Ericson, K.M., Laibson, D.I., Loewenstein, G. & Cohen, J.D. (2007). Time discounting for primary rewards. *Journal of Neuroscience*, 27(21): 5796-5804.

Mischel, W., Shoda, Y. & Rodriguez, M.L. (1989). Delay of gratification in children. *Science,* 244: 933-938.

Morrot, G., Brochet, F. & Dubourdieu, D. (2001). The color of odors. *Brain and Language*, 79, 309-320.

O'Doherty, J.P. (2004). Reward representations and reward-related learning in the human brain: Insights from neuroimaging. *Current Opinion in Neurobiology*, 14(6): 769-776.

Plassmann, H., O'Doherty, J. & Rangel, A. (2007). Orbitofrontal cortex encodes willingness to pay in everyday economic transactions. *Journal of Neuroscience*, 27(37): 9984-9988.

Plassmann, H., O'Doherty, J., Shiv, B. & Rangel, A. (2008). Marketing actions can modulate neural representations of experienced pleasantness. *Proceedings of the National Academy of Sciences of the U.S.A.,* 105(3): 1050-1054.

Rolls, E.T., McCabe, C., & Redouter, J. (2007). Expressed value, reward outcome, and temporal difference error representation in a probabilistic decision task. *Cerebral Cortex*, 18(3):652-663.

Samuelson, P. (1937). A note on measurement of utility. *The Review of Economic Studies*, 4: 155–161.

Simmons, W.K., Martin, A., & Barsalou, L.W. (2005). Pictures of appetizing foods activate gustatory cortices for taste and reward. *Cerebral Cortex*,15, 10:1602-8.

Schultz, W. (2000). Multiple reward signals in the brain. *Nature Reviews Neuroscience*, 1(3): 199-207.

Sheeran, P. (2002). Intention-behaviour relations: A conceptual and empirical review. *European Review of Social Psychology*, 12: 1-36.

Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological Review*, 117(2): 440-463.

Trope, Y., Liberman, N., & Wakslak, C. (2007). Construal levels and psychological distance: Effects on representation, prediction, evaluation, and behaviour. *Journal of Consumer Psychology*, 17(2): 83-95.

Tsukayama, E., & Duckworth, A.L. (2010). Domain-specific temporal discounting and temptation. *Judgment and Decision Making*, 5(2): 72–82.

Tusche, A., Bode, S., & Haynes, J.D. (2010). Neural responses to unattended products predict later consumer choices. *Journal of Neuroscience*, 30(23): 8024-8031.

Tversky, A., & Kahneman, D. (1981). The Framing of Decisions and the Psychology of Choice. *Science*, 211: 453-458.

Van Lange, P.A.M., Van Vugt, M., Meertens, R.M., & Ruiter, R.A.C. (1998). A social dilemma analysis of commuting preferences: The roles of social value orientation and trust. *Journal of Applied Social Psychology*, 28(9): 796-820.

Weijzen, P.L.G., de Graaf, C., & Dijksterhuis, G.B. (2008). Discrepancy between snack choice intentions and behavior. *Journal of Nutrition Education and Behavior*, 40: 311-316.

Winkielman, P., Berridge, K.C., & Wilbarger, J.L. (2005). Unconscious Affective Reactions to Masked Happy Versus Angry Faces Influence Consumption Behavior and Judgments of Value. *Personality and Social Psychology Bulletin*, 31(1): 121-135.

Zandstra, E.H. & El-Deredy, W. (2011). Effects of energy conditioning on food preferences and choice. *Appetite*, 57: 45-49.

FIGURES
Understanding Consumer Decisions Using Behavioural Economics
EH Zandstra *et al.*

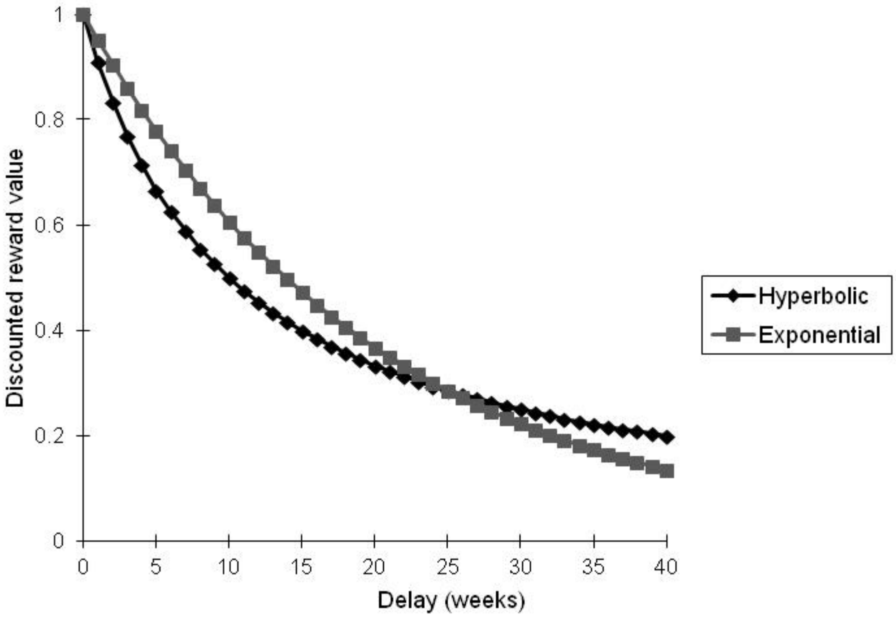

Figure 1. Example of discounted utility functions defined by exponential and hyperbolic function. Discounted values are calculated as per Eq.s 1 and 2, respectively.

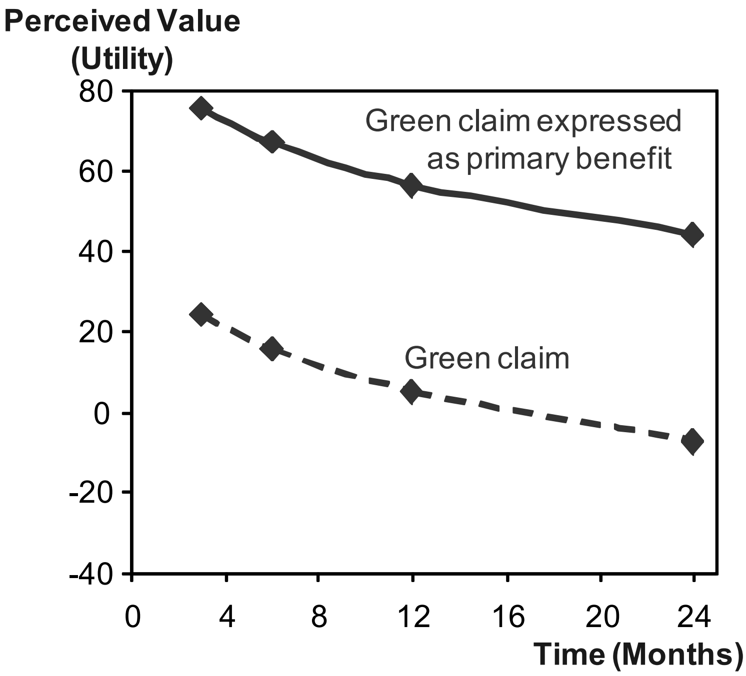

Figure 2. Boosting the perceived value of a delayed reward using tailored communication. The y-axis shows perceived values (estimated utilities), for one of the four green claims (dotted line) and the corresponding one of six primary benefits, which was found to be an optimal combination. The

solid line is obtained by summing the utilities of the green claim, the primary benefit and interaction term. Each of the main estimated utility terms are zero-centred by definition. Hence, the sum of them need not always be higher than the individual terms. The relative value can be compared between any pair of points.